

(12)

**EUROPEAN PATENT APPLICATION**

(21) Application number: 84303762.3

(51) Int. Cl.<sup>2</sup>: **F 16 F 13/00**  
**B 62 D 33/06, F 16 F 9/32**

(22) Date of filing: 05.06.84

(30) Priority: 16.06.83 GB 8316419

(43) Date of publication of application:  
27.12.84 Bulletin 84/52

(84) Designated Contracting States:  
BE DE FR IT NL SE

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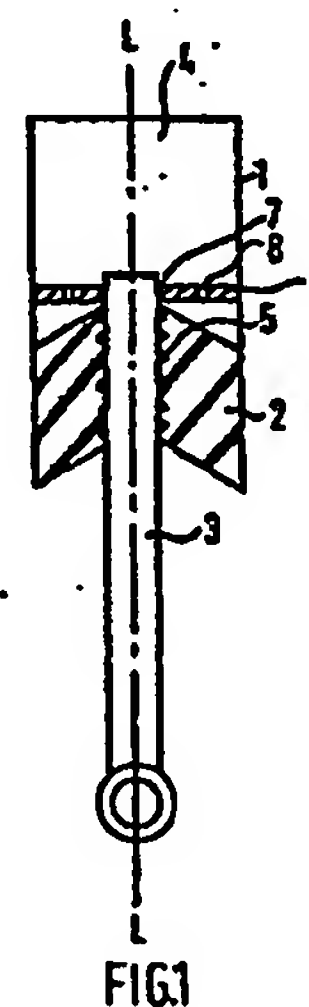
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(64) Spring.

(57) A spring comprises a hollow body (1) having an opening in which is mounted an elastomeric bush (2) through which a plunger (3) may slide.

The body, bush and plunger define a cavity (4) in which there is located support means (6) for providing non-rigid support for the plunger (3) in a sideways direction perpendicular to longitudinal axis of the spring whilst permitting longitudinal movement of the plunger relative to the body.

The cavity (4) is filled with incompressible fluid and when in use the spring is subject to compression loads the resulting movement of the plunger into the cavity increases the pressure of the fluid which flows through or around the support means (6) and deforms the bush (2). Further movement of the plunger ceases when the force acting on the end of the plunger due to the fluid pressure equals the externally applied compression load.



## SPRING

This invention relates to springs.

According to the present invention a spring for connecting two components comprises a hollow body adapted for connection to one of said components, an elastomeric bush mounted in an opening in the hollow body and having a through bore in which a plunger member adapted for connection to the other of said components is slidably received for reciprocating movement in a direction substantially parallel to the longitudinal axis of the spring, said hollow body, bush and plunger member defining a sealed cavity for containing a substantially incompressible fluid, and provided within said cavity support means of a kind which provides non-rigid support for said plunger member in a direction substantially perpendicular to the longitudinal axis of the spring.

The support means within said cavity may be of a kind which provides a non-linear resistance to movement of the plunger member in a sideways direction, i.e. a direction perpendicular to the longitudinal axis of the spring. It may permit substantially unrestricted initial movement of the plunger member from a rest position of the plunger member when in the absence of externally applied load and either prevent or, for example, provide progressively increasing resistance to further sideways movement of the plunger member. In an alternative arrangement the support means may provide progressively increasing resistance even to initial movement of the plunger member in a sideways direction.

The elastomeric bush in which the plunger member is slidably received preferably provides a resistance to movement of the plunger member in a sideways direction so as to assist, in conjunction with the support means in the cavity, in providing, in use of the spring, location of the plunger member substantially in alignment with the longitudinal axis of the spring when in an unloaded condition.

Preferably the spring is provided with means

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for pressurising or supplying pressurised fluid to the cavity. In consequence the length of the spring when subject to a given longitudinal load may be adjusted as required.

5           The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings wherein:-

10           Figures 1 and 2 are schematic representations of a spring according to the present invention to illustrate the principle of operation thereof;

Figure 3 is a vertical section through a spring according to the present invention in the mean laden condition, and

15           Figure 4 is a view similar to that of Figure 3 of a spring according to another embodiment of the present invention.

Referring first to Figures 1 and 2 there is shown a schematic representation of the spring according to the  
20 present invention. The spring comprises a hollow body 1, a rubber bush 2 and a plunger member 3.

In use the body 1 is connected to one of two components and the plunger member 3 is connected to the other of said two components.

25           The body 1 is shown in the form of a cylinder closed at one end and having the bush 2 mounted at the other end. The bush 2 is of chevron shape in cross-section having the apex end directed towards the inside of the hollow body in the unloaded condition.

30           The plunger member 3 is shown in the form of a solid cylindrical rod slidingly and rotatably received in a central through bore of the bush 2 for reciprocating movement in a direction substantially parallel to the longitudinal axis L of the spring.

35           The body 1, bush 2 and plunger 3 define a sealed cavity 4 which contains a substantially incompressible fluid inert with respect to the rubber of bush 2. The bore of the bush 2 is formed with a plurality of axially

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spaced annular grooves 5 which contain cavity fluid to lubricate the plunger 3 thereby minimising the friction and wear of the bush 2. The axial spacing of the grooves 5 increases towards the outer end of the bush 2 which has the effect of pumping the cavity fluid inwards during reciprocating movement of the plunger 3 thereby providing a seal between the plunger 3 and bush 2 to prevent loss of cavity fluid.

Provided within the cavity 4 is a support bush 6 of elastomeric material. The bush is secured by bonding to the internal surface of the body 1 and is provided centrally with a metal sleeve 7 through which the plunger 3 may slide freely. The bush 6 additionally is provided with six circumferentially uniformly spaced passages 8 through which the cavity fluid may flow in a substantially unrestricted manner.

Operation of the spring is as follows, starting from the unloaded condition shown in Figure 1. Compression loads applied in the direction of the longitudinal axis L force the plunger 3 into the cavity 4 and the fluid contained therein, being incompressible and unable to escape, exerts a pressure on the bush 2 causing axial, i.e. shear, deflection of the bush 2 up to the fully compressed position of the spring shown in Figure 2 in which the bush is inverted with respect to its starting position. The passages 8 enable cavity fluid to flow in a direction towards the bush 2 without requiring substantial deformation of the support bush as the plunger moves through the support bush 6 under the action of a compression load. The compression stiffness of the spring is dependent upon the ratio of the inner and outer diameters of the bush and its axial stiffness and any one or more of these parameters may be varied in known manner to provide the required spring characteristics for a given application. In addition the fluid in the cavity 4 may be either unpressurised or pressurised in the unloaded condition, the use of a pressurised fluid providing a recoil force at the zero deflection which may be advantageous for certain spring applications.

Any load tending to move the plunger 3 sideways, or subject it to conical motion, is resisted by the compression resistant elastomeric material of the axially spaced bushes 2,6.

5           Turning now to Figure 3 there is shown a spring according to the present invention suitable for use as a vehicle cab mounting, the spring being shown in the mean laden condition. The spring comprises a hollow body 20,  
10 bush 21 and plunger member 22 incorporating support means 23 which is of a kind to restrict sideways movement of the plunger member and to damp movement thereof. Body 20 comprises coaxial first and second cylindrical tubes 24 and 25 respectively. The tube 25 has an internal diameter greater than the external diameter of tube 24.

15           Tube 24 is closed at one end by a closure plug 26 having a filling opening 27 for the introduction of a substantially incompressible fluid (not shown) e.g. castor oil. The other end of tube 24 is open and  
20 received within one end of tube 25. Said one end of tube 25 is secured to a mid portion of tube 24 by an annular collar 28. The other end of tube 25 has bush 21 mounted therein.

          Bush 21 is of chevron shape in cross-section in the unloaded condition having the apex end directed  
25 towards the inside of body 20 in the unloaded condition. Bush 21 comprises a plurality of interleaving rubber layers 29 and metal plates 30 and has a central through bore 31 in which plunger member 22 is slidingly and  
30 rotatably received. A low friction gland seal 32 at the outer end of the bush 21 provides a fluid-tight seal between the bush 21 and plunger member 22.

          Body 20, bush 21 and plunger member 22 define a sealed cavity 33 within the body 20 in which the incompressible fluid e.g. castor oil is contained.

35           Support means 23 comprises a piston 34 slidingly received within tube 24. The piston 34 is in the form of a disc having an internal diameter slightly greater than the outer diameter of a cylindrical portion 39 of a flanged



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location bush 40 about which the piston is retained. The bush 40 is secured to the inner end of plunger 22 by a plug member 35 and a pair of Belleville washer type springs 41 hold the piston normally in an axially central position between the flanged end portion of bush 40 and a confronting surface of the plug member 35. The springs 41 have serrated edges thereby to permit a restricted flow of fluid through a usually annular space between piston 34 and location bush 40. Plunger 22 has an axially extending blind bore 36 closed at the outer end and open at the inner end to the fluid within the cavity 33 via bore 37 formed in plug member 35.

In use the spring carries the static load of a vehicle cab, the mean laden condition being shown in Figure 3. The body 20 is bolted to the vehicle frame (not shown) by means of bolts (not shown) received in threaded holes 38 formed in collar 28 and the plunger member 22 is secured to the cab (not shown) by means of a bolt (not shown) which passes through a central opening 42 in eyelet member 43 integral with plunger member 22. Operation of the spring is substantially as described with reference to Figures 1 and 2 above but with the support means 23 serving to dampen relative movement of the plunger 22 and tube 25 as well as give non-linear resistance to sideways movement of the plunger. That is, the plunger can freely move sideways relative to the piston 34 until the location bush 40 contacts the piston whereupon further sideways movement is prevented.

The fluid pressure within the cavity may be varied by either displacing the plunger on assembly or by an external pressurised fluid supply to the cavity, the latter enabling the static height of the cab to be adjusted.

In a further embodiment illustrated with reference to Figure 4 a spring, also suitable for use as a vehicle cab mounting comprises a hollow body 50, bush 51 and plunger member 52.

The body 50 comprises a first cylindrical tube 53 and coaxial therewith a second cast steel tube 54

of smaller internal diameter than tube 53 and formed integrally with an outwardly extending flange 55 by means of which the two tubes are secured together. The flange 55 is formed with threaded holes 56 for attachment of the  
5 spring to the chassis of a vehicle. The plunger 52 is provided with an eyelet fitting 57 for attachment of a cab structure thereto.

The second tube 54 is closed at one end by a plug 66 through which substantially incompressible fluid  
10 may be introduced to the tube 54. The other end of the tube 54 has a support bush 58 mounted therein, said bush comprising a cylindrical shaped elastomeric element 59 secured between and bonded to inner and outer cylindrical shaped metal members 60,61.

15 The outer member 60 is a friction fit in the tube 54. Provided within the inner member 61 is a friction fitted assembly of a support sleeve 62 and a low friction bearing 63, the sleeve 62 being arranged to be between the bearing 63 and inner member 61. The end  
20 portion of plunger 52 is able thereby to slide freely relative to the inner member 61 of support bush 58.

An end portion of the plunger 52 is formed with an axially extending bore 64 and at a portion of the plunger which does not extend into the cylindrical tube 54 there  
25 is provided one or more radially extending passage 65 each leading outwards from said bore 64 for restricted flow of fluid therethrough.

Provided in the first cylindrical tube 53 is the annular non-interleaved rubber bush 51. The bush 51  
30 has an inner tubular metal member 67 in which the plunger member is slidingly received. The two tubes 53,53 of the body 50, the bush 51 and plunger member 22 define a cavity 69 within which incompressible fluid, admitted through the plug 66, is contained. Associated with the  
35 member 67 is seal means 68 to prevent escape of pressurised fluid from the cavity 69.

When the spring is subject to a compression force fluid is caused to flow through the bore 64 and

passage 65 from that part of the cavity within tube 54 to that part in tube 53 such that an equal pressure exists in each part. The resultant pressure deforms the bush 51 and further deformation of the bush ceases when the  
5 force acting on the bush due to the fluid pressure associated with a particular position of the bush balances the resistance to longitudinal deformation of the bush 51.

A spring of a kind in accordance with the present invention is particularly suitable for use in  
10 mounting of a tiltable vehicle cab structure on a vehicle chassis. When a cab is tilted the usually vertically mounted springs experience a high sideways load and the provision of support means in the fluid cavity of each spring ensures that these loads can be withstood without  
15 damage and without adversely affecting the suspension characteristics of the cab during normal use of the vehicle.

It will be understood the spring according to the present invention has applications other than those for use as a cab mounting, for example the spring may be used in  
20 such applications as an automotive impact absorber and a railway buffer.



## CLAIMS:

1. A spring for connecting two components comprising a hollow body (1, 20, 50) adapted for connection to one of said components, an elastomeric bush (2,21,51) mounted in  
5 an opening in the hollow body and having a through bore in which a plunger member (3,22,52) adapted for connection to the other of said components is slidably received for reciprocating movement in a direction substantially parallel to the longitudinal axis of the spring, said  
10 hollow body (1,20,50) bush (2,21,51) and plunger member (3,22,52) defining a sealed cavity (4,33,69) for containing a substantially incompressible fluid, characterised in that there is provided within said cavity (4,33,69) support means (4,23,58) of a kind which provides non-rigid  
15 support for said plunger member (3,22,52) in a direction substantially perpendicular to the longitudinal axis of the spring.
2. A spring according to claim 1 characterised in that said support means (23) provides a non-linear variation of  
20 resistance to movement of the plunger member (22) in a direction perpendicular to the longitudinal axis of the spring.
3. A spring according to claim 2 characterised in that the support means (23) permits substantially unrestricted  
25 initial movement of the plunger member (22) from the position of the plunger member when in the absence of externally applied loads.
4. A spring according to any one of the preceding claims characterised in that the support means (4,58)  
30 provides a progressively increasing resistance to movement of the plunger member (3,52) in said direction perpendicular to the longitudinal axis of the spring.
5. A spring according to any one of the preceding claims characterised in that the support means (4,58)  
35 comprises a resilient bush (6,59).
6. A spring according to claim 3 characterised in that subsequent to said initial movement the support means (23) prevents further movement in said direction perpendicular

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to the longitudinal axis of the spring.

5 7. A spring according to any one of the preceding claims characterised in that the support means (23) is positioned in a portion (24) of the hollow body (20) of smaller cross-sectional shape than a portion (25) of the hollow body in which the elastomeric bush (21) is mounted.

8. A spring according to any one of the preceding claims characterised in that there is provided in said cavity a substantially incompressible fluid which is at 10 above atmospheric pressure in the absence of externally applied loads to the hollow body (1,20,50) and plunger member (3,22,52).

9. A spring according to claim 8 characterised in that said pressure is selectively variable.

15 10. A spring according to any one of the preceding claims characterised in that damping means (41,65) is provided within the hollow body (20,50).

11. A spring according to claim 10 characterised in that said damping means (41) is comprised by the support 20 means (25) within the cavity.

12. A spring according to claim 10 or claim 11 characterised in that said damping means (41) comprises attached to the plunger member (22) a piston (34) slidable relative to the hollow body and shaped to define an 25 aperture for restricted flow of fluid therethrough.

13. A spring according to claim 12 characterised in that the piston (34) is arranged for movement in a portion (24) of the hollow body (20) of smaller cross-sectional shape than a portion (25) of the hollow body in which the 30 elastomeric bush (21) is mounted.

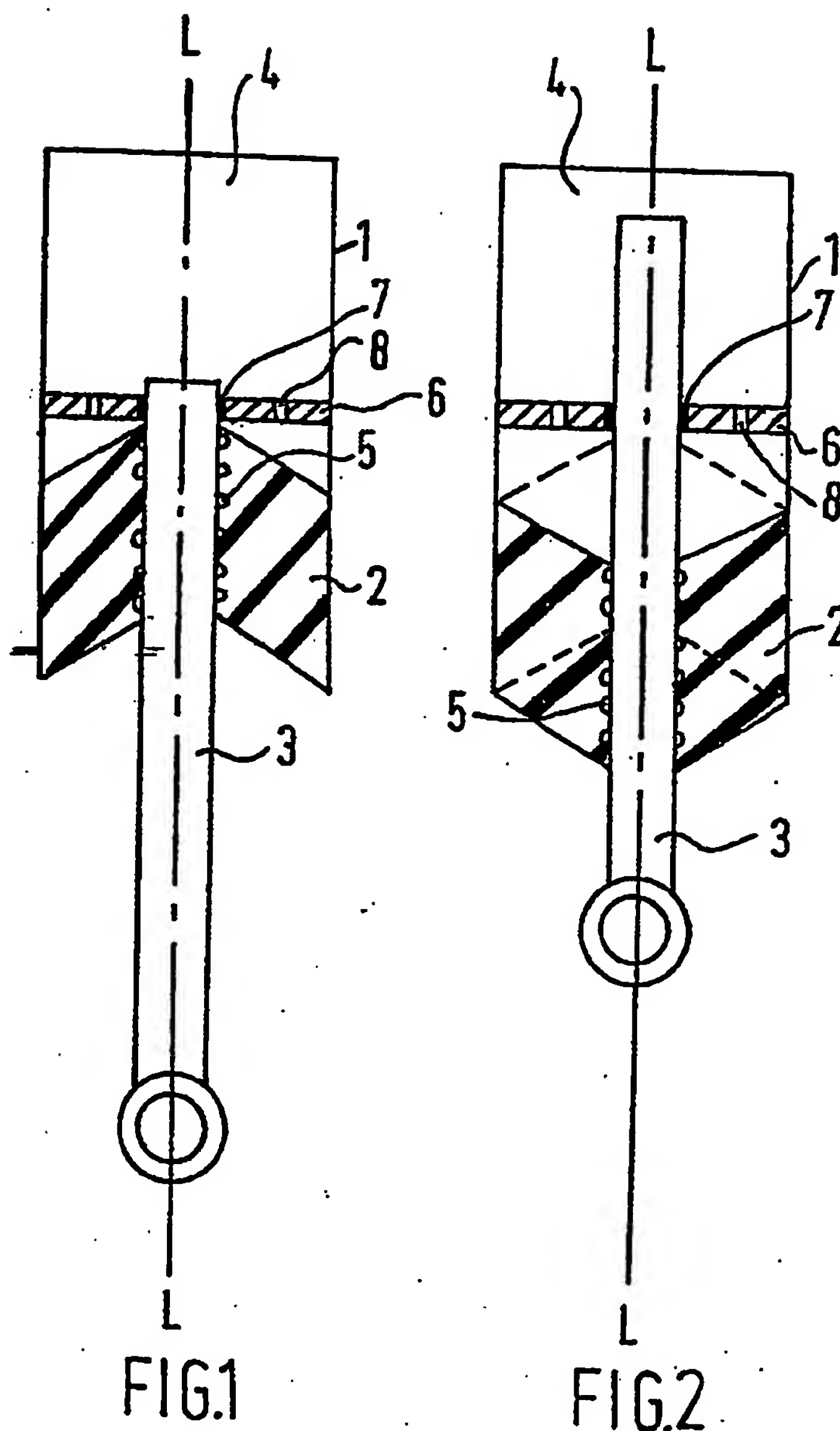
14. A spring according to any one of the preceding claims characterised in that the bush (21) comprises a plurality of interleaved rubber layers (29) and metal plates (30) arranged generally concentrically relative to 35 a central bore in the bush.

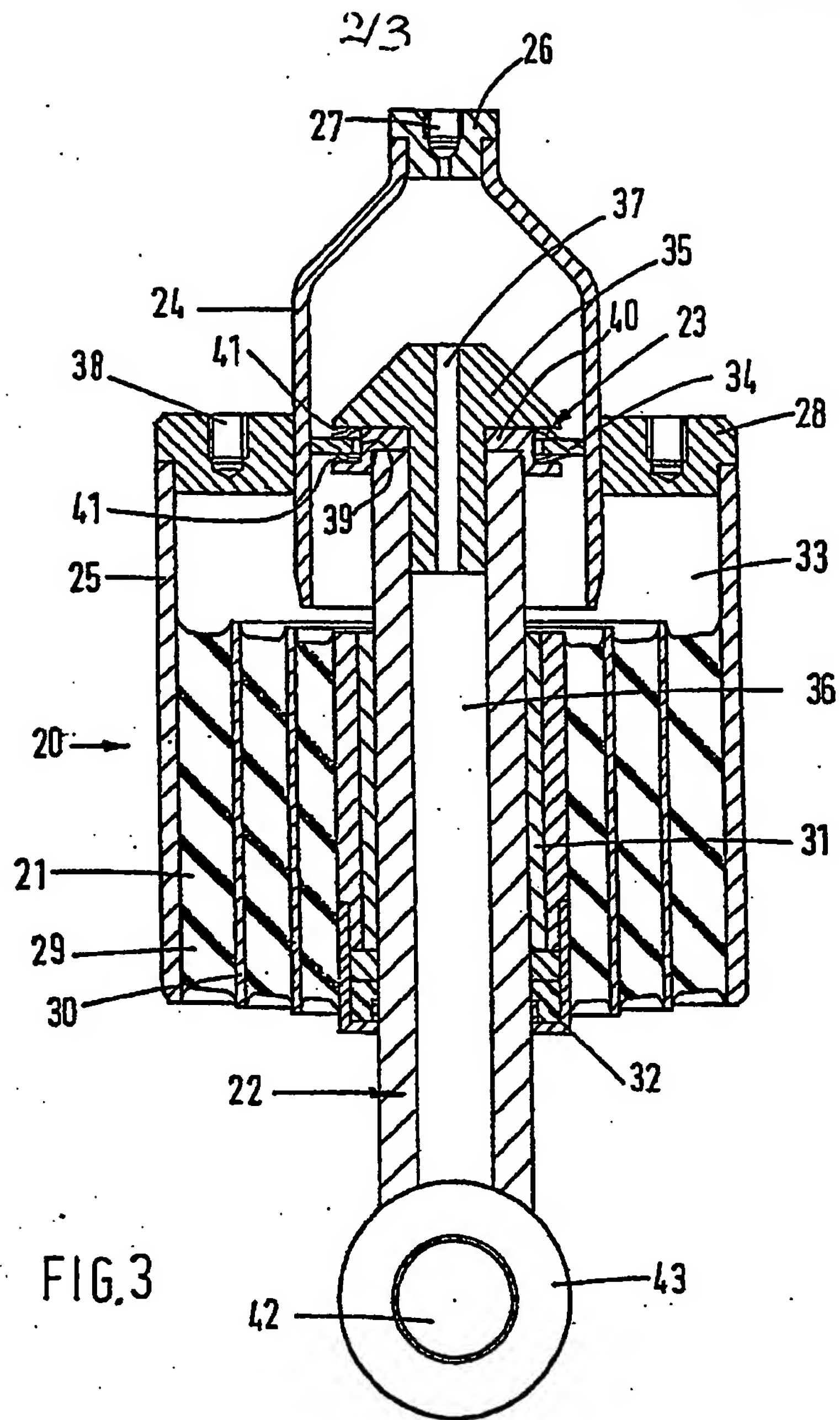
15. A spring according to any one of the preceding claims characterised in that the bore of the bush (2) is shaped to provide a plurality of axially spaced annular

grooves (5) for containing fluid to lubricate the plunger (3).

- 5 16. A spring according to claim 15 characterised in that the axial spacing of the grooves (5) increases towards an outer end of the bush (2).

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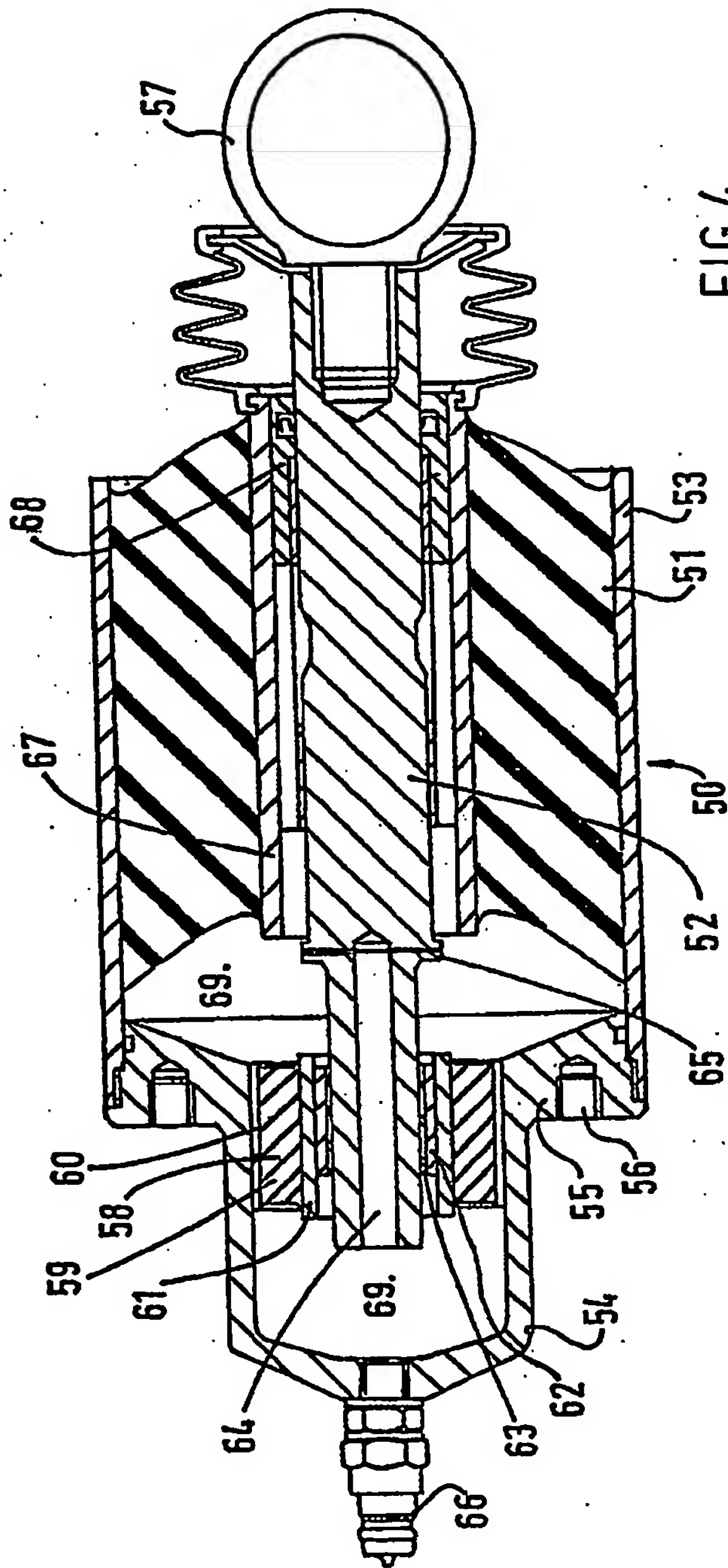


FIG. 4

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Europäisches Patentamt

European Patent Office

Office européen des brevets

(11) Publication number:

0 129 363

A3

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: 84303762.3

(61) Int. Cl.<sup>4</sup>: F 16 F 13/00

B 62 D 33/06, F 16 F 9/32

(22) Date of filing: 05.06.84

(30) Priority: 16.06.83 GB 8316419

(43) Date of publication of application:  
27.12.84 Bulletin 84/52

(66) Date of deferred publication of search report: 05.02.88

(64) Designated Contracting States:  
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(54) Spring.

(57) A spring comprises a hollow body (1) having an opening in which is mounted an elastomeric bush (2) through which a plunger (3) may slide.

The body, bush and plunger define a cavity (4) in which there is located support means (8) for providing non-rigid support for the plunger (3) in a sideways direction perpendicular to longitudinal axis of the spring whilst permitting longitudinal movement of the plunger relative to the body.

The cavity (4) is filled with incompressible fluid and when in use the spring is subject to compression loads the resulting movement of the plunger into the cavity increases the pressure of the fluid which flows through or around the support means (8) and deforms the bush (2). Further movement of the plunger ceases when the force acting on the end of the plunger due to the fluid pressure equals the externally applied compression load.

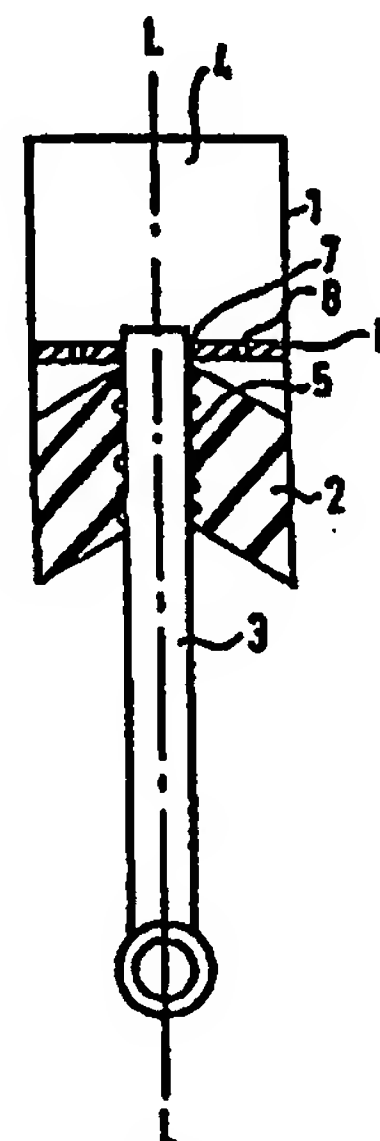


FIG. 1



European Patent  
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# EUROPEAN SEARCH REPORT

01 29363

Application number

EP 84 30 3762

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	FR-A-2 255 508 (PELAT) * Page 4, line 30 - page 7, line 27; page 8, line 5 - page 9, line 32; figures 1-5 *	1, 5, 8, 10-12	F 16 F 13/00 B 62 D 33/06 F 16 F 9/32
Y	FR-A-2 220 717 (NEK) * Page 9, claim 1; figures 1-4 *	1, 5, 8, 10-12	
Y	DE-A-2 717 825 (LOCHNER) * Page 3, paragraph 1; page 4, paragraphs 3, 4; figures 1-3 *	1, 8, 10	
Y	DE-A-2 730 046 (LOCHNER) * Figure 1 *	1, 8, 10	
A		5, 7, 11-13	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	FR-A- 932 616 (RIBBESFORD CIE.) * Page 2, ligne 87 - page 3, line 9; page 3, lignes 22-34; figure 1 *	1, 8-12	F 16 F B 62 D B 60 G
A	GB-A-2 027 517 (SOUTH AFRICAN INVENTIONS) * Front page; figures 1-4 *	5, 8, 10-12, 14	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 08-10-1985	Examiner ESPEEL R.P.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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# EUROPEAN SEARCH REPORT

0129363

Application number

EP 84 30 3762

DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
A	US-A-3 076 643 (BITTEC) * Column 7, line 6 - column 8, line 34; figures 3-6 *	1,8-10 ,12,15	
E	--- PATENTS ABSTRACTS OF JAPAN, vol. 8, no. 146 (M-307)[1583], 7th July 1984; & JP - A - 59 43 241 (NISSAN JIDOSHA K.K.) 10-03-1984	1,5,8, 10,11	
A	--- GB-A-2 087 511 (IMPERIAL CLEVITE)		
A	--- GB-A- 613 253 (GENERAL TIRE AND RUBBER)		
A	--- GB-A- 610 958 (THIRY)		
A	--- US-A-2 471 096 (THIRY)		
A	--- US-A-2 387 066 (HARDING)		TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 08-10-1985	Examiner ESPEEL R.P.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			